Contribution of Climate Fields from Dynamically Downscaled GCM to Predicting Peanut Yields in the SE USA

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Background

- SECC and AgClimate.org
- ENSO and crop yields
- Global climate model
- Dynamical Downscaling with nested RCM

Crop simulation with RCM fields

- CropGro CSM
  - Peanut – v. Georgia Green
- Site specific soil profiles
- Rainfed conditions
- Uncalibrated for sites
- 1994-2003
- Nine sites (AL, FL, GA)
- Data sources
  - NWS Coop Network
  - FSU Global Spectral model: T63 – 200 km2 or 1.8°
  - FSU Regional Climate Model
    - Two convection schemes: (1) RAS, (2) SAS

Bias correction

The downscaled regional model results are sensitive to the accuracy of the global spectral model fields, which may exhibit bias when compared with observations. These biases will be carried to the regional model scale during the nesting process. Thus, the dynamically downscaled data are bias corrected prior to use with the crop models to remove systematic errors. The bias correction applied here is described by Wood et al. (2002) and consists of remapping the exceedence probabilities (percentiles) of the predicted data to those of the observed data. For example, if a downscaled value of Tmax lies at the 60th percentile of the downscaled Tmax distribution (that is, not to be exceeded more than 40% of the time), the bias-corrected value would be the 60th percentile of the observed Tmax distribution, effectively removing the systematic error in the downscaled value. This step is particularly important for precipitation, because the regional climate model tends to produce a large number of wet days with small precipitation amounts. In the case of precipitation, the bias correction therefore also serves to correct the number of wet days.

Results

- Bias correction successful for Tmax, Tmin, SRAD
- Not successful for precipitation
- Systematic error identified by this bias-correction approach small relative to random error.

- BC RAS better for max T and SRAD
- RAW SAS better for rain

Spatial and Temporal Variability Assessment

- Overall the bias-corrected RAS forecast had the lowest combined spatial and temporal error in simulated peanut yields
- The greatest source of yield error is from rain, the errors of which are highly variable in time and space
- The bias correction approach we employed here did not substantially reduce yield prediction errors
- RCM (SAS) forecasts have provided yield predictions superior to ENSO climatology during strong El Niño years 1997-1998

Future Directions

- Use of crop models with relatively greater temperature sensitivity - developmental
- Improvement of RCM convective scheme has potential to enhance to crop yield applications
- Need better methods of bias correction for precipitation field – bias or error?
- Multi-ensemble methods to improve forecast (Two convective schemes and a ten day time span in the start date to create 20 member ensembles)